

**REMARKS**

With the entry of the present amendments, claims 1-11, 16, 18-20, 25, 27-30, 35, 37-39, 41 and 43 are pending in the application. Claims 12-15, 17, 21-24, 26, 31-34, 36, 40, 42, and 44-48 have been canceled. Claims 1-4, 7-9, 11, 16-20, 25-27, 35, 36, 39, 41 and 43 have been amended. Support for the claim amendments may be found throughout the application as filed including, but not limited to, paragraph 13.

The claim amendments replace the phrase “non-thermally and non-radiatively curing (or drying)” with the phrase “harden into a solid or semi-solid coating by drying at room temperature.” This replacement simply takes language from the definitions of “non-thermally and non-radiatively curing” in paragraph 13 of the specification and imports it into the claims. As such, these amendments do not present new issues that require further consideration and/or search by the Examiner and should, therefore, be entered. (MPEP 714.13.III)

In view of the following remarks reconsideration and withdrawal of the rejections to the application in the Office Action is respectfully requested.

**I. REJECTION OF CLAIMS UNDER 35 U.S.C. § 103(a), IN VIEW OF U.S. PATENT NO. 6,485,794.**

In the Office Action, claims 1-11, 16-20, 25-30, 35-39, 43 and 45-48 were rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent No. 6,485,794 issued to Li, et al. (hereinafter “Li”). Applicants respectfully traverse.

With regard to independent claims 1, 18, 39 and 41, the present rejection is essentially a reiteration of the rejection made by the Examiner in the previous Office Action. In response to that previous Office Action, Applicants argued that the methods disclosed in Li are fundamentally different from those claimed in the present application because the methods of Li are limited to methods for producing lubricant coatings using curing processes that fall into one of two classes, namely: 1) thermal curing and 2) radiation curing. Both of these processes, and the types of film formers that are utilized in these processes, are well defined in the polymer field. In contrast, the present application claims methods for the production of lubricant coatings using ambient curing, whereby polymers harden into a solid or semi-solid coating by drying at

room temperature. Importantly, the three curing processes (i.e., 1) radiation curing; 2) thermal curing; and 3) ambient (room temperature) curing) are recognized as *separate and distinct* processes in the polymer filed.

Applicants have enclosed two references that illustrate the art-recognized distinctions between thermal curing and radiation curing (as described in Li) and room-temperature drying processes (as recited in the pending claims). The first reference, “Introduction to Polymers and Resins” by Joseph A. Prane, published by the Federation of Societies for Coatings Technology (1986), defines “Air Dry” (i.e., room temperature drying) as a process in which a polymer system applied as a liquid is converted into a solid film at room temperature. (See 2<sup>nd</sup> and 3<sup>rd</sup> to last paragraphs on page 25.) This reference defines “Thermal Cure” as “*heating* of the polymer film at a temperature and for a time sufficient to cause a designated chain extension and/or crosslinking reaction to occur.” (See 3<sup>rd</sup> paragraph on page 26, (emphasis added).) Finally this reference defines “High Energy Curing” (i.e., a variety of radiation curing) as “free radical polymerization *induced by* the absorption of incident radiant energy . . . .” (See 2<sup>nd</sup> column on page 26 (emphasis added).) The second reference is an online Dictionary of Additives and Coatings, published by Troy Corporation, a manufacturer of paints and coatings for 40 years. This second reference provides the following definitions: 1) “Air Dry” - “a cure mechanism by which the coating cures at the temperature of the surroundings (ambient temperature)”; 2) “Thermal Cure” – a process in which “after application, the coating *temperature is raised* (usually in an oven)” (emphasis added); 3) “UV Cure” – “A coating curing mechanism involving UV light . . . . The UV light decomposes the molecules necessary to *initiate* the crosslinking reaction and to build the resin network.” (Emphasis added.)

These references clearly illustrate the art-recognized distinction between curing by drying at room temperature and curing by applying either heat or radiation to induce a crosslinking reaction.

The coatings of Li are all thermally or radiation cured. As one of skill in the art would recognize all of the film-forming ingredients listed in Li are either radiation or thermal curing film formers that cure by polymerization and crosslinking reactions induced by the application of radiation or heat from an external source. This is highlighted by the Examples in Li, all of which

are directed to compositions composed of film forming ingredients that do not crosslink, polymerize, or even dry at room temperature. Of the seven examples, six are focused on UV curing compositions. The remaining example teaches a thermal curing composition composed of a film former (Sartomer's CN 981 B88 acrylate blend) that will not cure below 90°C with any thermal initiator.

Applicants initially attempted to distinguish the ambient curing processes of the claimed methods from the thermally and radiatively curing processes of Li by specifying that the claimed methods involved compositions that were “non-thermally” and “non-radiatively” cured. However, in the Office Action, the Examiner relies on Li's teaching of compositions that may be *cured by* visible and fluorescent lamps, to assert that Li teaches compositions that are “non-radiatively and non-thermally cured” because, as defined in the pending application, non-radiative and non-thermal curing they may occur under ambient room lighting conditions which could involve visible and fluorescent lighting. In making this argument, the Examiner overlooks the fact that although ambient room lighting generally includes visible and/or fluorescent lighting, the compositions recited in the pending claims are not *cured by (and more specifically, are not dried by)* such lighting. In fact, the compositions of the present application would cure (i.e., dry) even in the dark. For this reason, Applicants believe the claims as previously presented are patentable over Li. However, in order to expedite the prosecution of this application, Applicants have amended independent claims 1, 18, 39 and 41 to clarify that the compositions are made by “allowing a liquid composition to harden into a solid or semi-solid film by drying at room temperature, without thermal or radiative curing.” It should be noted that this amendment is intended only to clarify, and not to change the substance of, the rejected claims. In view of these amendments, Applicants believe the ambient curing processes of the present claims are adequately distinguished from the radiative and thermal curing processes disclosed in Li and respectfully request that this rejection be withdrawn.

With regard to independent claims 27 and 43, the Examiner states, “it would have been obvious to one having ordinary skill in the art at the time the invention was made to [use] a mixture of film-forming ingredients based on their individually having been taught as useful in the composition.” Applicants respectfully traverse.

Applicants maintain their position that Li's disclosure of a composition containing "at least one film-forming ingredient" is not a disclosure of a composition containing a mixture of two polymers, for all of the reasons presented in Applicant's previous response. However, Applicants further submit that even if Li taught a composition containing a mixture of two polymers, Li does not render the particular combination of a hydrophobic polymer and an alkali soluble resin obvious because this particular combination provides greater than expected lubricating properties.

Greater than expected results are evidence of nonobviousness. (MPEP 716.02(a)) Evidence of greater than expected results may be shown by demonstrating an effect which is greater than the sum of each of the effects taken separately (i.e., determining "synergism"). (MPEP 716.02(a)) The previous statement from MPEP 716.12(a) quotes *Merck & Co. Inc. v. Biocraft Laboratories Inc.*, 10 USPQ2d 1843 (Fed. Cir. 1989), a case which is particularly relevant to the present application. The patent at issue in *Merck v. Biocraft* claimed a composition comprising two specific diuretics. The prior art reference asserted against the patent taught compositions containing combinations of diuretics and provided a list of various diuretics, including the two specific diuretics of the Merck patent. However, the prior art did not actually highlight the combination of the two specific diuretics claimed in the Merck patent. It is in this context that the court in *Merck v. Biocraft* stated that an inventor could distinguish his claims from the prior art by introducing evidence of unexpected "synergistic" properties, wherein the evidence demonstrates "an effect greater than the sum of the several effects taken separately."

As interpreted by the Examiner, the disclosure of Li is similar to the disclosure of the prior art reference cited in *Merck v. Biocraft*. In column 3, lines 29-67 Li provides a long list of film formers that may be used in the lubricating compositions taught therein. However, Li does not actually highlight the specific combination of a hydrophobic polymer and an alkali soluble resin, as recited in pending claims 27 and 43. (In fact, Applicants maintain that Li does not actually teach the use of a combination of two polymers at all.) It follows that Applicants can provide evidence of nonobviousness by demonstrating that the specific combination of a hydrophobic polymer and an alkali soluble resin provide greater than expected (i.e., synergistic) lubricating properties. Applicants have submitted a declaration demonstrating just this.

The enclosed declaration of Paul F. Lewis (hereinafter “the Lewis Declaration”) describes the results of a direct comparison of the lubricating properties of: 1) a solid lubricant composed of a hydrophobic polymer; 2) a solid lubricant composed of an alkali soluble resin; and 3) a solid lubricant composed of a mixture of the hydrophobic polymer and the alkali soluble resin. The three lubricants were tested using a short track conveyer test, as described in paragraphs 29-31 of the present application. As shown in Figure 1 of the Lewis Declaration, the results of the short track conveyor tests showed that the lubricant coating containing the hydrophobic polymer provided a coefficient of friction not lower than 0.13 and as high as 0.162. The results further showed that the lubricant coating containing the alkali soluble resin provided a coefficient of friction not lower than 0.126 and as high as 0.13. In contrast the lubricant coating containing a mixture of the hydrophobic polymer and the alkali soluble resin provide a coefficient of friction as low as 0.118 and only as high as 0.124, *substantially better than the coefficient of friction provided by either polymer component individually*. This result clearly demonstrates that the combination of the two polymers provide lubricating properties that are much greater than would be expected based on the lubricating properties of the individual polymers. Therefore, because the combination of a hydrophobic polymer and alkali soluble resin provide greater than expected results, this combination is not rendered obvious by Li, which merely provides a list of possible film formers that may be used in a lubricating coating. For this reason, Applicants respectfully request that this rejection be withdrawn.

## **II. REJECTION OF CLAIMS UNDER 35 U.S.C. § 103(a), OVER PCT PATENT PUBLICATION NO. WO 92/19505 IN VIEW OF LI.**

In the Office Action, claims 1-5, 10, 11, 18-20, 45, 46 and 48 were rejected under 35 U.S.C. § 103(a) as unpatentable over WO 92/19505 in view of Li. Applicants respectfully traverse.

In order to establish a prima facie case of obviousness the cited references must teach each and every claim limitation in the rejected claims and there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the references. (MPEP 2142). In the present case, the

references cited by the Examiner provide no suggestion or motivation to apply the stress cracking-resistant bottle coating of WO 92/19505 to a conveyor system.

In support of the rejection based on WO 92/19505, the Examiner stated, "it would have been obvious to one having ordinary skill in the art at the time the invention was made to apply the lubricating coating of WO 92/19505 to a conveyor system for the transportation of containers because Li et al. teach that similar lubricant compositions to those taught by WO 92/19505 can be applied to container or conveyor surfaces to lubricate the passage of containers." Applicants respectfully disagree with this statement for at least two reasons. First, WO 92/19505 does not teach a lubricant composition, as asserted by the Examiner. WO 92/19505 teaches a bottle coating that provides a bottle with resistance to stress cracking. (See, for example, the abstract and page 2, lines 17-23.) Applicants were unable to find any language in WO 92/19505 that suggested the bottle coatings described therein had lubricating properties. In fact, in tests described in WO 92/19505 where coated bottles were in contact with a conveyor belt, a conveyor belt lubricant was employed. (See page 15, lines 29-35.) Second, it is not clear in what sense the stress cracking-resistant bottle coating of WO 92/19505 is similar to the lubricating coatings of Li. The Examiner has provided no explicit support for the conclusion that the two compositions are "similar." As far as Applicants can tell, the coating of WO 92/19505 and the lubricants of Li have been classified as similar simply because the coatings of WO 92/19505 are polyurethane based and the lubricants of Li might, in some instances, contain a polyurethane. Applicants respectfully submit that the mere fact that a stress cracking-resistant bottle coating and a conveyor lubricant might have some ingredients in common is insufficient to suggest to one of ordinary skill in the art that the stress cracking-resistant bottle coating could be used as a conveyor lubricant. Therefore, because the Examiner has failed to establish a prima facie case of obviousness, Applicants respectfully request that this rejection be withdrawn.

With regard to claims 18, 30 and 41, Applicants further note that the recited coefficient of friction is not an inherent property of the stress cracking-resistant compositions of WO 92/19505, as asserted by the Examiner.

The fact that a certain characteristic may be present in the prior art is not sufficient to establish the inherency of that characteristic. (MPEP 2112.IV) In relying upon the theory of inherency, the Examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art. (MPEP 2112.IV)

In the Office Action, the only basis for the assertion that the coatings of WO 92/19505 would inherently have the claimed coefficient of friction was the Examiner's statement that "the coefficient of friction is an inherent property of the *lubricant* composition." (Emphasis added.) However, as discussed above, WO 92/19505 does not actually teach a lubricant composition. Therefore, the Examiner has provided no basis to reasonably support the determination that the stress cracking-resistant coatings of WO 92/19505 would inherently provide a coefficient of friction of less than 0.15, as recited in claims 18, 30 and 41. For this additional reason, Applicants respectfully request that this rejection be withdrawn.

### **III. REJECTION OF CLAIMS UNDER 35 U.S.C. § 112, FIRST PARAGRAPH.**

In the Office Action, claims 45-48 were rejected under 35 U.S.C. § 112, first paragraph for failing to comply with the written description requirement. Applicants respectfully disagree with this rejection. However, in order to expedite the prosecution of this application, claims 45-48 have been cancelled without prejudice to Applicants' right to prosecute these claims in a timely filed continuation application. In light of this cancellation, Applicants respectfully request that this rejection be withdrawn.

### **IV. REJECTION OF CLAIMS UNDER 35 U.S.C. § 112, SECOND PARAGRAPH.**

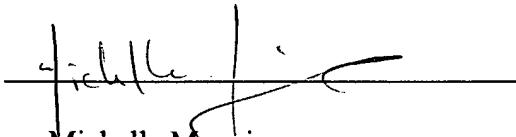
In the Office Action, claims 17, 26 and 36 were rejected under 35 U.S.C. § 112, second paragraph as being indefinite. Claims 17, 26 and 36 have now been cancelled. In light of this cancellation, Applicants respectfully request that this rejection be withdrawn.

In view of the foregoing remarks, Applicants respectfully submit that all of the claims remaining in the application are in condition for allowance and favorable action thereon is respectfully solicited.

Respectfully submitted,

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# Introduction to Polymers and Resins

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# Introduction to Polymers And Resins

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useful for preparing polymers that are unstable at the higher temperatures normally used in step-reaction polymerization.

**3. SUSPENSION POLYMERIZATION:** In this technique, the monomer is dispersed in water in small droplets (about 0.1 to 1  $\mu\text{m}$  in diameter) maintained by vigorous stirring. This method is used extensively for the free radical polymerization of vinyl monomers. A monomer-soluble initiator is added and polymerization occurs within each droplet. Generally, a material such as polyvinyl alcohol or gelatin is added to provide a protective coating for the droplets. This prevents the droplets from cohering when they are at the intermediate stage of being composed of a tacky mixture of monomer and polymer. The continuous water phase facilitates the removal of exothermic heat of reaction. In addition, suspension polymerization has the advantage that the polymer is obtained in the form of small beads which are easily collected and dried. The polymer is relatively free from contaminants and there are no solvent recovery considerations.

Non-aqueous dispersion (NAD) polymerization<sup>2</sup> is a technique that is closely allied to suspension polymerization, but which also has some ties to organosols and emulsion polymerization (as described in the following discussion). In NAD addition polymerization of vinyl monomers (e.g., methyl methacrylate), the essential features are:

- The monomers are soluble in the continuous phase (which is usually an aliphatic solvent);
- The polymerizing monomer is precipitated from solution as a fine particle size seed (1-5 microns) which is stabilized by a graft copolymer stabilizer. Such graft polymer stabilizers contain chains of moieties soluble in the continuous phase (e.g., 12-hydroxy stearic acid or lauryl acrylate) attached to a polyacrylate or polymethacrylate backbone, the latter being compatible with the base polymer;
- The locus of subsequent polymerization is the polymeric seed particle and the continued particle growth is dependent on the amount of monomers fed into the reaction vessel;
- Provided that the operating conditions are fully optimized, particularly with regard to the stabilizer level on monomers, no further nucleation of particles occurs, and a uniform particle size distribution results, ranging from 2-10 microns.

NAD's have been used in automotive topcoats for a number of years as thermosetting acrylic/amino resin combinations. They have been effective in reducing the number of coats required to build up a specified dry film thickness—and have allowed users to employ low solvent solvents and to substantially reduce their solvent emissions. However, they are currently being replaced by the next generation of automotive topcoats, namely high solids enamels.

**4. EMULSION POLYMERIZATION:** In this important process, the monomer is dispersed in water containing a surface active agent (usually about 3-6%) to form an emulsion. Such a dispersion is stable and its existence is not dependent on continued agitation. This technique is extensively used for the free radical polymerization of diene polymers (i.e., in styrene-butadiene emulsion copolymers) and for vinyl polymers (i.e., for emulsion polymers of vinyl acetate and acrylate and methacrylate esters and their interpolymers).

In these cases, a water-soluble initiator is used, and the course of the polymerization is considerably different from that in the previously described systems. At the start of an emulsion polymerization, three components are present:

- Relatively large droplets of monomer, about 1-2 microns in diameter, stabilized by surfactant molecules around the periphery;
- Aggregates (micelles) of 50-100 surfactant molecules swollen with monomer to a diameter of about  $10^{-2}$  micron;
- The aqueous phase containing a few monomer molecules and the initiator which gives rise to free radicals.

The monomer droplets and the micelles swollen with monomer compete for the free radicals generated in the aqueous phase. However, since there are many more micelles than droplets in the system, most of the free radicals enter micelles, where polymerization is initiated. The monomer consumed during the resulting polymerization is replenished by diffusion of new monomer molecules from the aqueous phase, which, in turn, is kept saturated with monomer from the droplets of monomer. Polymerization continues within a given micelle until a second free radical enters the micelle, in which case termination occurs quickly because of the small volume of the reaction locus. The micelle then remains inactive until a third free radical enters, and so on.

As the reaction proceeds, the micelles become larger and are disrupted to form particles of polymer swollen with monomer, the particles being stabilized by surfactant molecules around the periphery. Monomer continues to diffuse into these particles and polymerization is maintained therein until the monomer supply is exhausted. The final product is a stable dispersion (also called emulsion or latex polymer) of polymer particles with diameters in the range of 0.1 to 1 micron.

The polymer can be isolated by "breaking" the emulsion, usually by the addition of acid. In the coatings industry, the emulsion polymers are used directly without coagulation, for example, in the preparation of latex paints from polyvinyl acetate or acrylic ester polymer emulsions. An attractive feature of emulsion polymerization is that it is possible to prepare very high MW materials (in the 1,000,000 range) at high rates of conversion.

### C. Polymer Curing Methods; Crosslinking

In the coatings industry, polymer systems are designed to optimize their conversion from applied liquids (or dry powders) to the final solid films with the required appearance and performance properties. References to curing and crosslinking techniques have been made frequently in previous sections. In this section, these methods are summarized since their practice is so essential in the coatings industry.

**1. AIR DRY:** This method of conversion to a solid film is characteristic of three types of polymer systems, applied as one component compositions at room temperature:

a) **LACQUERS**—These are solutions of polymers such as nitrocellulose and shellac which form films by solvent evaporation.

b) **THERMOPLASTIC EMULSION POLYMERS**—e.g., acrylic polymer emulsions. These form films by evaporation of water followed by the coalescence of the emulsion polymer particles.

c) **OXIDATIVE CURE**—This is exemplified by polymers based on vegetable drying oils, e.g., linseed, soya, etc. These include the oils themselves, alkyd resins, epoxy esters, urethane oils and alkyds (ASTM Type 1) and oil-based varnishes. The double bonds in the oil fatty acids react with oxygen in the air, aided by catalysis with driers (for example, cobalt and manganese salts), to form crosslinks through peroxide, hydroperoxide, and C-C bonds.

2. **FORCED DRY**: This is a special case of air dry where heated air is conducted over the air dry polymer solution or dispersion to speed the evaporation of solvents or water.

3. **THERMAL CURE**: This important industrial process involves the heating of the polymer film at a temperature and for a time sufficient to cause a designed chain extension and/or crosslinking reaction to occur. Thermal energy can be imparted by a convection oven or by infrared irradiation.

Many of the systems described earlier can be thermally cured, e.g., short- to medium-oil alkyds, alkyd/amino resins, thermosetting acrylics, etc. Typical cure times and temperatures can range from 110°C for 45 min to 170°C for 10 min; each system has a specific time/temperature relationship to overcome the induction period, and to produce optimized cure and performance—consistent with assembly line schedules.

4. **CHEMICAL CURE**: This cure mechanism involves specific chemical reactions, often at room temperature, to produce useful crosslinked compositions.

a) **ONE COMPONENT—Moisture Cure**—Moisture-curing urethanes, when spread as films in air, absorb moisture

from the air and proceed to react by chain extension and crosslinking to eventually form polyureas—with the elimination of CO<sub>2</sub> (ASTM Type 2). Silicones and polysulfides are also available in forms which are moisture-curable.

b) **TWO COMPONENT**—These systems are widely employed:

1) **Base plus catalyst or activator**—Typical of this category are the epoxy systems previously described. Also included are catalyzed urethanes (ASTM Type 4).

2) **Reactant A plus Reactant B**—This class is exemplified by epoxy/polyamines or polyamides previously described and by ASTM Type 5 urethanes (polyol plus polyisocyanate).

3) **Vapor Permeation Curing (VPC)**—VPC involves the extremely rapid, ambient temperature curing of a coating in the presence of an atmosphere of catalyst vapor. The catalyst is specific for the polymer system in the coating, e.g., tertiary amine vapor for epoxy, urethane, or phenolic polymers. Most of the current industrial systems are based on hydroxyl-functional urethane polymers.

4) **High Energy Curing**—Ultraviolet (UV) and electron beam (EB) curable systems are based on free radical polymerization induced by the absorption of incident radiant energy at room temperature by monomer/prepolymer combinations, e.g., acrylics and acrylic-urethanes. In the case of UV cure, photoinitiators (e.g., benzophenone or benzoin derivatives) are decomposed by 325-365 nm UV light, initiating addition polymerization. EB performs a similar function, but without the need for photoinitiators.

Other high energy curing sources, e.g., gamma rays (from isotopes such as Cobalt 60), plasma and laser beams, have been used for curing polymers. However, their use in coatings has been minimal.

## IV. MOLECULAR WEIGHT OF POLYMERS

Frequent reference has been made to the concept of molecular weight of polymers. This characteristic is of considerable importance since it has a significant effect on such properties as solubility, rheology, dry speed, and performance.

Theoretically, the MW of a linear addition polymer is simply:

$$\text{MW (polymer)} = \text{DP} \times \text{MW (monomer)}$$

where DP = degree of polymerization, or the number of monomer units (mers) that have formed the chain.

For condensation polymers, the relation is more complex, depending on the functionality of the monomers and the extent of polymerization.\*

However, virtually all of the polymers used in the coatings industry, because of their manufacturing methods, are actually mixtures or distributions of polymers of various MW. Consequently, depending on the method of measurement, a number of MW averages are determined, and cited in the literature.

The two most important measures of MW averages are:

$$\begin{aligned} \bar{M}_n &= \text{number-average MW} \\ \bar{M}_w &= \text{weight-average MW} \end{aligned}$$

The ratio  $\bar{M}_w/\bar{M}_n$  indicates the breadth of distribution of MW species in the polymer. These and other measures of MW averages are discussed in the following sections.

### A. Number-Average Molecular Weight<sup>67-68</sup>

The number-average MW counts the number of molecules of a particular weight and averages this over the total number of molecules.

$$\bar{M}_n = \frac{N_1 M_1 + N_2 M_2 + \dots}{N_1 + N_2 + \dots} = \frac{\sum N_i M_i}{\sum N_i}$$

where:  $M_1$  = MW of species 1 (compared to hydrogen with MW = 1)  
 $N_1$  = number of molecules of  $M_1$   
 $M_2$  = MW of species 2  
 $N_2$  = number of molecules of  $M_2$   
 $M_i$  = MW of the  $i$ th species  
 $N_i$  = number of molecules of the  $i$ th species  
 $\Sigma$  = summation

### B. Weight-Average Molecular Weight

The weight-average MW averages the weights of each of the different MW species or segments distributed throughout the polymer.

$$\bar{M}_w = \frac{w_1 M_1 + w_2 M_2 + \dots}{w_1 + w_2 + \dots} = \frac{\sum w_i M_i}{\sum w_i}$$

where  $w_1, w_2, w_i$  = weight of molecules of species 1, 2 and  $i$

Vinyl Acrylic  
Viscosity (Dispersion)  
Viscosity (Rheology)  
VOC

Xylene

Yellowing

LAC, Troysol 380W and Troysol S366.



**Adhesion Promoter-** An additive that is either applied to the substrate or added to the coating to increase the coating-to-substrate adhesion. Chemistries to promote adhesion to metal include silanes, titanates, zirconates, and alkyl phosphate esters. Chlorinated polyolefins promote adhesion to polypropylene or thermoplastic olefin.

Wetting additives such as Troysol LAC, Troysol 380W and Troysol S366 are not considered adhesion promoters because they do not create chemical bonds between the coating and the substrate. However, improvements to peel strength (a test method to measure adhesion) have been observed after including Troysol LAC.



**Air dry-** A cure mechanism by which the coating cures at temperature of the surroundings (ambient temperature). The term usually applies to coatings that require oxygen to crosslink double bonds (this is also called oxidative dry or oxidative cure). An oil-alkyd architectural coating is an example of an air dry coating.

Troymax and Troykyd driers accelerate the cure of air dry coatings.



**Antifoam Additives-** A class of additives that prevent problems with foam by attacking foam at the source of its creation. Antifoam action may also include coalescing small bubbles (microfoam) to larger bubbles to increase the bouyancy of the bubbles (large bubbles rise faster).

Troy performance defoamers and grind defoamers provide antifoam action to fight foam at its source of formation.



**Ball Mill-** A rotating cylinder with large media (example: 1 cm radius) that is used to grind a mill base. The throughput of a ball mill is slower than other technologies, and the shear force is less. A ball mill may provide a pigment grind with a more narrow particle size distribution than other technologies.



**Bénard Cells-** A hexagonal pattern formed when circulation currents created by solvent evaporation separate



**Thermal Cure (Stoving)**- After application, the coating temperature is raised (usually in an oven). The higher temperature reduces the time required for a chemical reaction (for a reactive cure coating). It may allow a coating chemistry to be used that wouldn't undergo chemical reaction at room temperature.



**Thermal Sag**- The higher temperatures in an oven reduce the viscosity of a coating, increasing the tendency for sag.



**Thixotropy**- A coating has thixotropy if the viscosity after application is significantly lower than the viscosity prior to application. The phenomenon can be observed if viscosity is plotted on a graph vs. shear rate. A curve is plotted as the shear rate increases, and then a second curve is plotted as the shear decreases. The second curve is lower than the first curve, and the area between the two curves is the measure of thixotropy.

Troythix 150ACS, Troythix 250XF, Troythix 21BA, Troythix A, and Troythix XYZ increase the thixotropy of a nonaqueous formulation.



**Tint base**- A white coat that will be tinted with a color pigment concentrate. A tint base is a "pastel base" if there is a high concentration of titanium dioxide--the color will be lighter, and the coating will provide more opacity. A tint base is a "deep base" if the concentration of titanium dioxide is lower--the color will be deeper, and there will be less opacity.

Troy wetting additives aid in achieving the expected color, by preventing a loss of color pigment dispersion when the color pigment paste is mixed with white paint (Troysol LAC and Troysol 380W for aqueous formulations and Troysol S366 for nonaqueous formulations).



**UV Cure**- A coating curing mechanism involving UV light (a higher frequency and a shorter wavelength). The UV light decomposes the molecules necessary to initiate the crosslinking reaction and to build the resin network. Coatings cured by UV Cure are generally clearcoats (no pigment) or low pigment concentration. If the pigment concentration is too high,

the pigment will reflect the UV light and prevent the decomposition of the initiator. UV cure times are very fast (cure times often are less than a second).



**Vinyl Acrylic-** The term usually refers to an aqueous formulation with an acrylic polymer latex polymer that includes both acrylic monomer and vinyl acetate monomer. (See also Acrylic and Styrene Acrylic).



**Volatile Organic Compounds-** In the United States, the term refers to any material in a formulation other than water (and some exempted materials) that will evaporate from a sample placed in a forced draft oven at 110 C for 60 minutes (EPA Method 24 - Surface Coatings).



**Viscosity (Dispersion)-** Viscosity is a measure of the resistance to flow. For a pigment mill base (or color pigment concentrate) the dispersion of the pigment particles decreases the viscosity. In aqueous systems, dispersing additives can provide the mill base with a very low viscosity, similar to the viscosity of water.



**Viscosity (Rheology)-** Viscosity is a measure of the resistance to flow. A rheology modifier may increase the viscosity to meet a specification. It may also be used to minimize or correct a problem such as sag or sedimentation.

Troythix XYZ and Troythix A increase all viscosities of nonaqueous coatings, and are incorporated in the grind stage of production. Troythix 21BA and Troythix 42BA are similar in function, but differ in chemistry, allowing incorporation in the letdown or post-add stage. Troythix 21BA is for pigmented coatings, whereas Troythix 42BA is for both pigmented coatings and clear coatings. Troythix 42BA provides a more Newtonian-type viscosity increase.



**Wetting (substrate wetting)-** The ability of the coating to maintain contact over the substrate surface. Without good wetting, the coating will "crawl" away from the surface, exposing large surface areas, or move away from low surface energy contaminants to expose small areas (craters). Good wetting requires a low surface tension for the coating, a surface tension lower than surface tension of the substrate, and the